3 Development Tracking

3.1 Overview

Development tracking at its most basic is the measurement of change in land use brought about by human development. Quantifying this change is essential in order to assess evolving needs in infrastructure planning and evaluate environmental implications. The State of Maine currently has no uniform and consistent method of capturing this change.

Before any system can be developed, Maine needs to prioritize what data describing these impacts and changes are necessary to adequately inform analysis, planning and policymaking. What development is most necessary to track? Is it growth of public infrastructure? Is it the number of new houses with the fiscal and environmental impacts this creates? Is it land cover, or the measure of impervious surface (roads, structures, parking areas) vs. farmed or forested land with their respective influences on stormwater runoff and habitat disturbance? Is it the changing size and ownership pattern of land parcels? Is it the actual organization of the built environment within a developed area and the impacts this has on service delivery and community character? The answers to these questions have serious implications on the preferred system of development tracking to be implemented.

The challenge of this analysis is to determine Maine's most useful and cost-effective approach in pursuit of development tracking in the near-term future, informed by the strengths, limitations, challenges and costs of the various options.

The following objectives will guide this analysis:

1. Development tracking needs to be implemented statewide but must remain useful at municipal scales and accuracies.
2. The system should be operational in a short period of time (within 12 months).
3. The system must be economical to build, maintain and operate.
4. The system must integrate cleanly with higher accuracy data as such data becomes available.
5. The growth indication data must contain a temporal component. These must be compatible with a baseline going forward. Data from 2002 should be directly comparable with data from 2012 or 2020.
6. All data utilized in development tracking must be retained in the Maine Public Library of Geographic Information: There is to be zero data loss and no stranded investment where state funding is used to create these products.

3.1.1 Development Tracking is an Integrated Subset of the Statewide Plan

The overall Maine GIS data enhancement initiative outlined in this report is being designed to address many of the foundation requirements of creating effective

development tracking. If the recommended program is implemented, many general data improvements will occur: Roads, updated regularly and accurately and including information about type and condition as well as address information, will provide a network useful for geo-coding new development and quantifying impervious surface area. Land cover will be captured and classified using satellite imagery, producing useful information describing agriculture, forest types and developed areas at scales suitable to watershed or regional analysis. Zoning districts will be more thoroughly and consistently automated and made available in digital format. Highly accurate aerial photography will be completed for the whole of the state and distributed freely through the Public Library of Geographic Information.

Still, none of these data products will capture land use and development change in a manner satisfying multi-scale utility and accuracy or near-term statewide availability. Additional growth indicator data must be added to the Geographic Library to establish the baseline of developed area and measure change moving forward.

3.2 Data Sources

3.2.1 Development May Be Described by Different Data Types

The following comparison of the various data feature types will serve as a guide to the different classes of development indicators. The choices made between these will largely determine what analysis and presentation products will be feasible, and help define the specific data collection and maintenance challenges ahead.

The basic data types useful for development tracking can be grouped into line-based, point-based, polygon-based or image-derived strategies. These vary enormously in cost to implement as well as in analytic utility. Following is a brief description of each.

3.2.1.1 Line-based

The following set of three images is a sequence illustrating progressive development over time as measured by a line based system. These lines represent existing roads captured by the GIS at uniform intervals of time. The pattern is clear, though not extremely detailed or informative.

Figure 3-1: GROWTH INDICATED by LINES (ROADS)

Road centerline data figure importantly in current Maine GIS, and are not presently being fully utilized for their development tracking capabilities. Road lines may be buffered to approximate developed land, as has been undertaken in some areas by Inland Fisheries and Wildlife. They can be converted to polygonal data to produce a composite of undeveloped un-roaded areas or "eco-blocks," such as those currently being used by The Nature Conservancy or in a similar format by the Department of Conservation Natural Areas Program. They can be modeled according to their functional classes and other attributes from the rich data set maintained by the Department of Transportation. DOT's Travel Demand Model for forecasting statewide traffic growth may be called upon to augment the development tracking system. This is especially true to the extent it can be used to measure and model urban population and employment dispersal to non-urbanized areas in the state.

Some of the most useful line-based approaches to development tracking system follow.

Roads

New development can be captured as it is added to the E-911 road network. Development tracking can piggyback on the existing system as communities report new road development to MeGIS through the established addressing methodology. There is a fully developed process established for feeding data into this system that involves nearly every community in the state. Of the 492 organized townships in Maine, 323 have presently completed the MeGIS E-911 readdressing process, which involves globally positioning existing road centerlines and creating address ranges for structures along the roads. All but 16 organized municipalities are participating in the addressing system in some way. Approximately 125 of the 422 unorganized townships are also being readdressed for E-911. To maintain the system, municipal addressing officers are instructed to notify MeGIS when new roads are developed. MeGIS then sends a contractor to globally position the new road centerline to be added to the statewide network. The number of participants required to successfully operate the initiative provides some sense of the complexity in maintaining even this simple line-based development measurement layer.

DOT roads, to the extent that they are actively updated, provide similar capabilities and possess a rich set of attributes. The updating methodology for DOT is focused more on public road modeling, so it is not as desirable a source as the E-911 layer for monitoring growth at the fine capillaries of the transportation network where the much of the residential building occurs.

When these two roads layers are combined as is planned within the next year, a single source will be available providing the best qualities of each. Spatial accuracy will be assured by the constant updating efforts of the E-911 program, attached to the rich attribute set maintained by the DOT.

Private source roads can also provide data tracking of this variety. Vendors such as GDT, ETAK, and NavTech develop and sell accurate GIS road networks. These vendors purchase Maine DOT and MeGIS data, integrate it with other sources, package it

commercially, then charge $5,000 or more per year to re-license it as a statewide layer to end users. Most of the quality improvement is feature enhancement in densely populated areas to ensure proper road directionality, geometry and intersection integrity for navigational purposes. This data product succeeds in year-to-year consistency, but fails the requirement of statewide accuracy, especially in rural areas.

Linear Infrastructure

Public water and sewered areas as defined by physical infrastructure locations are another linear data source, and in certain cases far more useful to development tracking than street centerlines. This is true even if these features are only captured to planning level or schematic accuracy. Sewer extensions almost universally portend land subdivision and infill as soil percolation requirements or contaminant loading limits are eliminated with their construction. These data are digitally available for most sewered areas in Maine, at least as system-wide schematics, and could be quickly automated from existing hardcopy system maps elsewhere. Costs for maintaining these data could likely be at least partially offset by the utilities themselves. These data are obviously useless in non-sewered areas, or the overwhelming majority of the state.

Electrical, telephone or data distribution utilities are useful as predictive indicators of development as well as built environment. Accurate maps of communication capacities, including fiber networks, broadband cable and DSL access areas, are predictors of future developmental and demographic change as well as helpful components in characterizing the current state of development. Both Bangor Hydro and Central Maine Power maintain detailed GIS layers of their entire electrical transmission and distribution systems.

There are conflicting sentiments among Maine utilities regarding exchange and sharing of proprietary system data with state agencies or the public at large. Reasons for opposition include liability concerns associated with potential data inaccuracies, faulty analysis undertaken beyond the utility's control, and missed opportunities of capitalization by the utility on data that have in most cases been very expensive to acquire. Typically water and sewer utilities are more willing to freely exchange data than electrical and communications utilities.

3.2.1.2 Point-based

The next three images illustrate the same development sequence as above using points. The lines are retained for reference, as they will be available statewide and likely used as the addressmatching source data. The points represent approximate center locations (centroids) of a growing number of property parcels. By itself this picture does not quantify what manner of physical development is occurring. With these anchor points established though, other data sources such as municipal assessing records or county Registry of Deeds data could be attached to augment them. Visually this product would have a similar appearance whether collected using global positioning equipment or interpreted from aerial orthophotography.

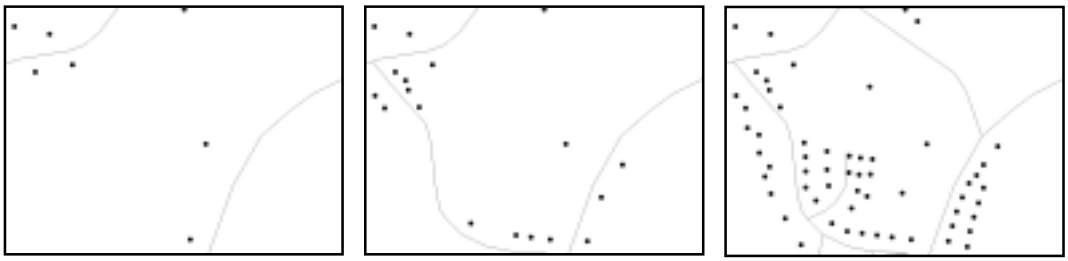

Figure 3-2: GROWTH INDICATED by POINTS (with Roads)

Geocoded Pemits

Assigning geo-located points to each individual property provides a more accurate means of tracking development than any linear features alone. This approach is used by New York State and elsewhere to track real estate parcels. The latitude and longitude coordinates of these properties are approximate, based on the size and location of the land parcels, but they are linked to assessing data and can be mapped thematically. In Maine the logical way to capture this type of feature set would be to geocode address records of one or more growth indicators.

Building permits are a good example of this, though in Maine these are not reported uniformly statewide and no aggregation point exists at which those that are reported can be summarized at a state level. New housing units authorized by building permits in 2000 numbered approximately 6,200.

Plumbing Permits are more universally available and presently aggregated in the DHS Wastewater and Plumbing Control Program. Approximately 40,000 plumbing permits are processed annually (generating $275,000 in dedicated revenue). It should be feasible to work with sewer districts to collect new and upgraded sewer connections to supplement the plumbing permit data and provide essentially full statewide coverage.

Utility Pole Permits. Maine utilities are required to get permits in cases where they are going to be adding poles to the network. In cases where areas are being electrified in anticipation of building, such permits constitute a useful advance indicator of development. When the poles have been set, their GPS'd locations with date installed are maintained by the utility. These data would be valuable from a development tracking perspective, but utilities are typically unwilling to share them. It is highly unlikely that CMP or Bangor Hydro will voluntarily share their pole location data with the State Planning Office or other state agencies to assist this initiative.

Electrical Connection Permits. The Subdivision Control Law and the Shoreland Zoning Law of Maine prohibit a public utility from installing services to a lot in a subdivision (Title 30, Subsection 4956.4), or a structure in a shoreland area (Title 38, Subsection 444) without appropriate municipal authorizations. The necessary authorization forms are provided by the electric utilities and processed by municipal code officers, inspectors and sometimes volunteer selectmen or planning board members. Once completed these are re-submitted to the utilities prior to physical electric hookups. Since these forms must

pass through town offices and city halls to have map/lot numbers and appropriate signatures added, the constitute a potential collection point for valuable growth indicator data.

Telephone Connection Data

Telephone connection data are maintained as a complete data set by Verizon, which is under contract with the state for maintaining the Enhanced 911 database. Like electrical utility connection data these present a potentially valuable resource for tracking growth: despite the cellular revolution, nearly every Maine structure contains phone service and the data require accurate address information for emergency response. But these are also private, proprietary data protected through complex negotiations for a single-use purpose, making them unlikely components of a development tracking system. Given the close working relationship between MeGIS and the E911 project, it might be possible to explore whether a subset of this database might be appropriately made available for development tracking purposes. If determined to be feasible, such a step may require statutory authorization.

Municipal Addressing Records

One of the changes made with the enactment of Maine's E911 system is that official physical addresses, which also serve as postal addresses, are assigned by municipalities. During development of the statewide system, 431 towns (330 organized and 98 unorganized territory townships) had points collected. These consist of locations corresponding to driveways and front doors of structures, and these points have been snapped to accurately geocoded address centerlines. Each point represents an existing structure and was assigned an address. Each point was also coded to indicate whether it was a residential, commercial, industrial, public use and of one or more units. Municipal addressing committees verified and corrected the field work to arrive at a very accurate rendering of existing structural development at the time the points were gathered. These points are now all geocoded by address and municipalities have been and will continue to assign addresses for all new structures as they are built. Physical addresses must be assigned by a municipality before mail can be delivered or utility service can be established. Therefore, in the vast majority of instances (other than remote seasonal cases), municipal addressing can be expected to occur.

This system is one which should be further explored to determine its feasibility for use for development tracking. At this time there is no plan or mechanism for centralized collection of new address points as the E911 system itself is fed through the Verizon telephone database described above. The large number of municipal officials that would need to participate in such a data gathering project is a clear hurdle for this approach but they are already established and networked through communication related to the E911 and road centerline file updating processes. On the plus side, the maps provided to the municipalities who engaged in the addressing process are extremely popular, used by fire departments and other officials, and represent an active routine exposure to GIS at the local level. During the process of verifying these maps, addressing committees gained an awareness of new development that had been occurring in their communities. A development tracking system that returned updated maps to municipalities would have

recognized local value for multiple purposes. In any event, the archived set of points from the date of collection sometime over the last 8 years provides a critical base dataset from which to calculate change.

3.2.1.2.1 Fine Tuning Locational Points

Slightly more accurate than addressmatched permit locations will be layers consisting of structures or other visible features that have been digitized to current orthophotography or captured in the field with GPS receivers.

An example of this would be using the E-911 lines layer to addressmatch permit locations, then manually adjusting these to correct locations over current orthophoto imagery. This presupposes the existence of current aerial or satellite photography containing all evidence of new development. Since statewide 1-meter digital ortho quadrangle data represents a funding outlay of well over $3 million using current technology, this would be an extremely expensive approach for capturing new growth at regular intervals.

But such imagery would still provide a valuable resource in the locational tuning process. The E-911 program has created accurate, addressmatched points for 431 towns (330 organized and 98 unorganized territory townships) and "snapped" these to locations on road centerlines like a string of pearls. These "pearls" consist of locations corresponding to driveways and front doors of structures and include attribute information describing which side of the road they belong on.

Since new development constitutes only a small percentage of all built structures, the vast majority of these points could be quickly and easily migrated to appropriate roof locations on the DOQQ photographs.

Satellite-captured 10 meter panchromatic SPOT imagery could provide a marginal basis for augmenting out of data photography, but it would need to be purchased frequently. MeGIS took delivery on statewide SPOT imagery in 2001 and this data is licensed for use by all government and educational users in the state. Current cost of this is approximately $15,000/year.

The level of effort involved in migrating large numbers of points this way would vary widely according to methodology used. Currently the process can be undertaken easily and effectively using out of the box ArcView 3.2 with data that currently can be downloaded from the MeGIS web site (except for the address points themselves). It is tedious work, but with an optimally configured operating environment productivity could easily exceed 250 points per hour. Attachment of crucial Map/Block/Lot attribute information would slow the process considerably but properly formatting and integrating existing assessing tables prior to the positioning process would increase productivity.

Approaches would vary depending on availability and condition of assessing data, but one hypothetical strategy would involve the following steps:

1. Select all assessing records taxed for containing structural improvements on the property
2. Match these assessing addresses to addresses derived from point locations on lines, and Link tables
3. Use linked tables to display address, owner name and Map/Block/Lot information to technician
4. Using these attribute hints, guide the point from the centerline to its appropriate rooftop location
5. With the points correctly places, generate a geographically-derived unique identifier and drop all fields except the Map/Block/Lot concatenation from the points attributes.

The result of this process would be a point set correctly positioned over structures with a unique identifier recognizable to MeGIS and the State Planning Office, that could be used by the municipality to visually display attributes of its entire assessing database.

With the foundation points in place this a similar process could be used to capture newly occurring development. Ideally the technology for doing so would be made accessible to a large group of collaborating data maintainers using Web-based point and attribute editing tools.

3.2.1.3 Polygon-based

3.2.1.3.1 Property Parcels

The next three images are a time sequence illustrating development of this same land as depicted with property parcels. These paint a much clearer and more accurate picture of property fragmentation, describing precisely how land is fractured into smaller and denser units of consumption. These data are typically maintained by individual municipal assessing departments, and represent a very expensive and complex data creation and maintenance challenge. Not only must the polygons be kept up to date, but the underlying attribute information with the many fields of information used to assess property values must maintain their precise linkage to them.

Figure 3-3: GROWTH INDICATED by POLYGONS (PARCELS)

Parcels are the standard of land use measurement for they represent the legal boundaries of ownership. As GIS features, parcels are extremely useful in that they can be graphically depicted using various colors or symbols that correspond to their underlying attribute values. For instance, a GIS user can ask a map which parcels are contained in a given zoning district and light these up, painting an accurate picture of the district as a whole. Or properties of a particular value range can be selected and displayed as a subset of the whole. The same queries using points provide no sense of the corresponding area of selected parcels.

Statewide property parcel–based development tracking will require participation of potentially hundreds of individual data maintainers. Numerous states have struggled with the creation and maintenance of parcel data over their entire land area, but none has succeeded yet. As an example, Tennessee is presently undertaking a statewide initiative, and is estimating a total cost of over $50 million to complete.

Ultimately parcels cannot be kept out of a statewide development tracking strategy. This is because they are maintained locally and contain the best technical information relating to geometric dimensions and property condition. As part of the Statewide GIS Implementation Plan, parcels will continue to be developed independently in different parts of the state according to available resources and need. Currently more than 75 communities maintain digital parcels or have them in process (including the entire Unorganized Territory under the jurisdiction of LURC and the Maine Revenue Service), though these are stored and updated according to a variety of scales, accuracies and formats, and can't be effectively integrated without more consistency of content and maintenance. It is essential to recognize that a point-based development tracking system that positions these points accurately will accelerate parcel development and utilization by serving as the automatic link to assessing databases. With such points in place, as soon as parcel lines are accurately drawn they can be lit up with the best available attribute information.

The statewide GIS implementation plan proposes creation of strict standards to guide future parcel development and maintenance. All data developed using state funding will be required to meet these standards and will reside in the Public Library of Geographic Information. With proper funding and technical incentives, parcel development will be fostered in areas experiencing or subject to the most serious growth pressures and their unified format will facilitate regional and watershed-wide analysis.

However, for at least the next five years parcels will remain a spotty and undependable data source for development tracking statewide.

3.2.1.3.2 Other parcel Uses

Parcel polygons can also be useful in development tracking as subsets of municipality-wide layers. Subdivision plans and land surveys undertaken as conveyance instruments in land ownership transactions could be collected and integrated. If every property

survey undertaken in the state every year could be acquired, geographically registered and digitized into the Library of Geographic Information, an invaluable development tracking source would be created. Unfortunately this is not data that is captured at Registries of Deeds or anywhere else. County Registries of Deeds are not map-centric, and the critical link between book/page → map/lot → parcel geometry is not made until individual assessors interpret deed references and make changes locally. Streamlining this process and facilitating clean communication between these intimately connected data sets could revolutionize land modeling and visualization.

Unfortunately, barring huge advances in coordination among surveyors and a well-staffed collection mechanism to draw these resources into the Library, this will not be a dependable source of statewide development tracking data for a number of years.

Another polygon-based development indicator consists of building footprints and other accurately digitized planimetric features. These are the ultimate resource for visually describing the state of development in a mapped environment. Such feature locations and shapes provide extremely accurate representations of not only where the buildings are but their precise geometric shapes, whether streets include sidewalks, the configuration of driveways and even locations of fire hydrants and public benches. The comparison of such a data product (at right) with the line-point composite is striking.

Figure 3-4: POINT and POLYGON DATA COMPARISON

The mechanism for capturing these features involves technical tracing of shapes from highly accurate aerial photographs and is extremely expensive, often costing hundreds of thousands of dollars for a single community. A few of the highly urbanized areas of the state have undertaken development of this high quality data, but it is outside the reach of most jurisdictions and will continue to be so for many years.

3.2.1.4 Imagery-Derived Tracking

A wide array of imagery sources exists that provide utility in development tracking. These include conventional aerial photography and orthophotography (images with their distortion corrected to allow them to layer correctly with other mapped features) to a growing array of satellite-acquired data that include varying color and resolution characteristics. These are commercially available at a wide range of prices.

For purposes of development tracking, higher resolution is generally better. Resolution describes the size on the ground of the pixels constituting the image (e.g., 1-meter imagery is a mosaic of individual shades, each measuring one square meter on the ground). The ability to discern individual roof shapes and other built features rather than vague shades and colors aids in feature detection, and is impossible using a product like 30-meter Landsat imagery and marginal using 10-meter SPOT. File size increases dramatically with resolution.

Cost also increases with resolution. Maine has recently taken delivery on statewide satellite (SPOT) imagery at 10-meter resolution for a cost of about $15,000. The City of Saco has just spent $30,000 for 6" resolution data for its relatively small municipal area.

Coarseness of imagery does not preclude it from being useful for development tracking. If it can be captured in a repeatable fashion year to year and is inexpensive it can provide a lot of utility for regional or statewide analysis. Remotely sensed (captured from cameras on satellites) data meets these criteria. The following table summarizes some of the more common satellite data sources currently used for development tracking and land cover classification over the continental United States.

SOURCE	Black and White	STATEWIDE COST (B&W)	Color	STATEWIDE COST (COLOR)	Comments
LandSat7	15 meter		30 meter	$6,500	Both bands are captured onboard simultaneously. Can be fused and co-registered. Satellite has only been up 2-3 years. Scenes are 180km/side. Should be rectified using best available DEMs. Captured (satellite flyover) ever two weeks. Should be obtai
SPOT	10 meter		10 meter	$15,000	Maine has purchased SPOT statewide as of 09/2001. Often used with 30meter Landsat for "colorization" Color is derived from fusing with LandSat7 imagery
IRS	5 meter	$250,000	20 meter	$250,000	(4) visible bands. B&W and color can be fused. Engineered like old LandSat.
Space Imaging IKONOS	4 meter	$2,500,000	1 meter	$3,800,000	(4) visible bands. Just announced a price reduction. Problems with cloud cover. Guarantees no better than 20% cloud cover. Prices will probably drop again by summer 2002.
SPOT5	2.5 meter		10 meter		(4) multispectral bands (3 color, 1 IR) Launches Q2 2002; will be used to upgrade 10meter offerings
EROS (Israeli)	1.5 meter	$1,800,000	N/A		"Guarantees" cloudless coverage in 6 satellite passes.
Digital Globe	61 cm		2.44 meter		Recently launched. Quickbird Satellite. Good data in 4-5 bands. Won't be commercially available until end of 2002
Aerial Orthophotography	.5 meter	$2,300,000	.5 meter	$2,900,000	Average vendor prices for statewide at uniform half meter resolution. Significant savings will be yielded by varialbe resolution capture over different areas of state.

Table 3-1: REMOTE SENSING (Satellite) IMAGERY DATA

3.3 Development Tracking Implementation

3.3.1 Point Based System

The most likely candidate data layer suitable for Maine development tracking will be **point**-based. Parcel polygons, linear features or data captured from repeated satellite or

aerial photography will be used collaterally and integrated going forward, but complications in standardized, statewide collection and cost prohibitions make points a better initial development indicator.

The point feature layer must provide a dependable anchor to attach underlying attribute data. It must be collected with good spatial accuracy and both physical, recorded address and Map/Block/Lot identification. This will permit forward and backward compatibility with data maintained on the property at municipal, regional and state levels. Map/Block/Lot will provide a link to most data maintained at Registries of Deeds and municipal offices such as Assessing. Accurate addresses will allow the data to link to most other data sources.

One of the attribute fields in the point layer will contain date information, corresponding to either a permitting event or the date of the feature's entry into the system. This date value will allow analysis of development patterns over time. The points should also contain attribute information defining them as commercial or residential and enumerating the number of units if residential.

Of the numerous data layers investigated, each offers potential benefits as a foundation growth indicator, although none is an obvious winner. For purposes of system illustration the points derived from the **Electrical Connection Certification** form may be considered as a promising candidate. Most of the essential components of a point-based growth indicator are covered by this layer, and there is an existing collection methodology for assembling and aggregating the points. The form used for data collection is standard among all electrified areas statewide. A copy of this form is included in this document as **Attachment G.**

The preliminary table structure below describes the basic data that would be collected to fulfill this layer's role as a development tracking growth indication layer.

FIELD	FIELD DESCRIPTION	TYPE and VALID VALUES
MPLGI_ID	Maine Public Library of Geographic Information Identification Number	STRING
MAP	Municipal Map Sheet Number	STRING
BLOCK	Municipal Block Number	STRING
LOT	Municipal Lot Number	STRING
ST_NUM	Street Address Number	STRING
ST_NAME	Street Name	STRING
ST_SUFFX	Street Name Suffix	STRING
ZIPCODE	Physical Zip Code	ZIP
COMRES	Commercial or Residential Flag	STRING < C/R >
CON_DATE	Connection Date	DATE
UNITS	Number of Units (If Residential)	FLOATING POINT

Table 3-2: Development Tracking POINTS DATA DEFINITION

The unique MPLGI_ID that is used to index these points will serve as a stable, dependable locator to which many other sources of data can be attached. It would likely

be a concatenated x,y pair in Maine's standard UTM Zone 19 meters projection. This would represent the physical structure location as closely as it could be ascertained either visually from orthophotos or via GPS. Using this strategy would guarantee uniqueness and eliminate the need to test the ID against the existing bank of already assigned numbers before committing it to the structure. The number could be two integers separated by an underscore, and would look like:

430200_4925620

This identifier could also be used to integrate the high quality geocoded data delivered as part of the E-911 project. While these are snapped to road centerlines and as such don't specifically represent structure locations, their accuracy on lines would facilitate efficient mass-relocating over orthophotos to positionally correct them. Existing points could be dragged into the roof area or footprint apparent on the photograph. In cases where parcels exist, Map/Block/Lot could be automatically assigned via a spatial join.

Newly constructed buildings wouldn't be locatable this way, but utilizing the existing capabilities of the E-911 municipal addressing officers these points could be added with a high degree of accuracy.

Ideally an online tool would be available to facilitate this data input. This would be a simple interface allowing the user to visually navigate to a location based on road centerlines and orthophotographs, then add a point with appropriate Map/Block/Lot identification and send this to the GeoLibrary for validation and incorporation into the overall data layer.

As the universe of mapped structure locations increases, the MPLGI_ID could become a de facto standard for home and business locations in the State of Maine. Any number of attributes could then be mapped to these with superior ease and confidence. Whether building or plumbing permits, telephone connection data, well contamination reports, epidemiological, noise or animal nuisance data, the presence of a MPLGI_ID will permit high accuracy mapping to a common point.

3.3.2 Human & Technical Resource Requirements of Development Tracking

Data Collection

The necessary data components to feed the system could be collected by municipal addressing officers or town code enforcement officers when assembling necessary information to fulfill electrical connection sign off. A mature system would include a Web application that allowed the point to be placed on a digital map including a combination of orthophotography, attributed roads and other reference features. Along with the point the officer would populate all appropriate data fields and submit the data to the Public GeoLibrary. An appropriate MPLGI_ID would be assigned. Additionally, the data could be transmitted to the electric utility company to fulfill the certification

requirement for the new structure. This would eliminate the need for conveyance of paper documents.

Because the ultimate objective of this system would be an exhaustive, statewide structures database, the large number of existing structure points would need to be repositioned from their current road centerlines to within the footprints of the buildings themselves.

Data Users

Ideally a development tracking system will be useful and accessible to all levels of government and the general public. At its most basic, the system must be useable by the State Planning Office to illustrate statewide growth patterns over successive intervals of time. The point data combined with rudimentary basemap layers (roads and political boundaries) will satisfy this need. These data may be accessed through an Internet application served from the Public Library of Geographic Information or another location, or viewed locally using ArcView.

Due to the inclusion of reference fields to the map, block and lot index, municipalities will be able to link these points to their assessing records or other community data keyed with these identifiers. They will also be able to relate them directly to parcel boundaries if these exist. In fact, in towns where parcel polygons are digital and up to date, it will be possible to harvest these for use in another system by referencing them through the map/block/lot identifier.

Regional Councils will be able to use the structural age data derived from Connection Date values or assessing information to uniformly assess all new construction within their jurisdictions. These could be used in conjunction with all other data layers in the Public GeoLibrary. Analyses based on proximity of new buildings to the approximately 200 mapped growth zones throughout the state would be a typical, easily executed query that could be satisfied with these data without adding value through manipulated repositioning.

Manually repositioning the address points to actual structure locations will enhance the analytical value of the data by allowing more accurate GIS queries relating to impact on sensitive areas such as wetlands and prime farmland soils. It might also be possible to characterize relative building size and/or impervious surface coverage (e.g. < .25 acre, .25-.49 acre, .5-1 acre, >1 acre) to assist in analyzing potential impacts. The cost-effectiveness of this strategy should be tested through the pilot initiative described below and integrated into the planned transition to a parcel-based system over time.

Technical Support

Regardless of which municipal official(s) is/are tapped to capture and report original data, technical support will be required. Initially, this will require field support within each municipal office, ideally provided through the regional GeoService Centers. For municipalities that requested more assistance, the GeoService Centers might actually perform the data gathering function on behalf of the municipality. Coordination for data

acquisition would be provided through the GIS Outreach Coordinator of the Maine Public Library of Geographic Information.

User support for applications would be provided by a combination of the Library Outreach Coordinator as well as support staff at the various Maine GeoService Centers.

3.3.3 Pilot Application / Proof of Concept

In order to test the feasibility and efficiency of a development tracking solution based on structure points, a pilot project should be implemented. This project would include a small number of municipalities and would test application of software, data management techniques and mobilization of human resources necessary to collaboratively capture and maintain this planning resource. The critical components necessary to develop this solution include:

- Creation of a Maine structures points file carrying a unique identifier and a link to the municipal database (establishment of file standards). This includes integrating current E-911 feature attributes and developing a roll-up mechanism to allow for local variation and statewide aggregation;
- Validation mechanism to ensure all changes comply with GeoLibrary standards;
- Training in the use of the point-manipulation application;
- Completing actual data capture;
- Determinining analytical value to all data users;
- Evaluating administrative, financial and utilitarian aspects of the program;
- Making recommendations for moving forward.

Recommended but not essential add-on components that would enhance the effectiveness of development tracking for resource impact analysis:

- Application (preferably Web-based) to facilitate manipulation of positional accuracy of these points and addition of new points as structures are erected;
- Training in the use of the point-manipulation application.

Estimated costs for this pilot are outlined in Section 3.5.

3.3.4 Integrating Regulatory, Environmental and Demographic & Economic Development Data

Along with the development tracking core growth indicators, the full suite of Public GeoLibrary data will be available for integration and analysis.

Regulatory Data include layers such as shoreland zoning, flood hazard areas and special use overlays. These are necessary for delineating legal boundaries and attributes of

physical land areas. Growth indicator information used in concert with regulatory data will describe whether or not structures are being erected in conformance with legally established boundaries.

Data sources used for modeling the natural environment that will be useful in development tracking applications include water features, wetlands, soils (might be worth mentioning prime farmland separately), slopes, aquifers, floodplains, conservation lands and landuse/landcover data derived from satellite or aerial photography. These layers will be essential for constructing buildout analysis scenarios and characterizing land as having development potential. Environmental constraints data such as these can be stacked to illustrate areas least favorable to development potential. Plotting these together with growth indicator points will reveal patterns where building is occurring at a potential environmental danger or expense.

Economic development data include such layers as Tax Increment Financing Districts, Business & Industrial parks and Mapped Growth Zones. Plotting development points against Mapped Growth Zones will very quickly reveal locations where growth is either responding well to growth area incentives or proliferating outside of planned boundaries. Such a system will provide invaluable support to policy evaluation efforts such as whether a Tax Increment Financing District actually attracted the desired development activity. Assessing attribute data would allow for ready analysis of investment comparisons within and outside targeted districts and data such as number of jobs could be easily related to geography.

An exhaustive list of data layers identified as suitable and applicable to development tracking is attached as **Attachment H.**

3.4 Advanced Development Tracking Applications

With the point-based growth indicator layer established, its maintenance and update regime in place, and full integration with other GeoLibrary data sources ensured, the foundation will be set to build a large number of high end planning and analysis applications.

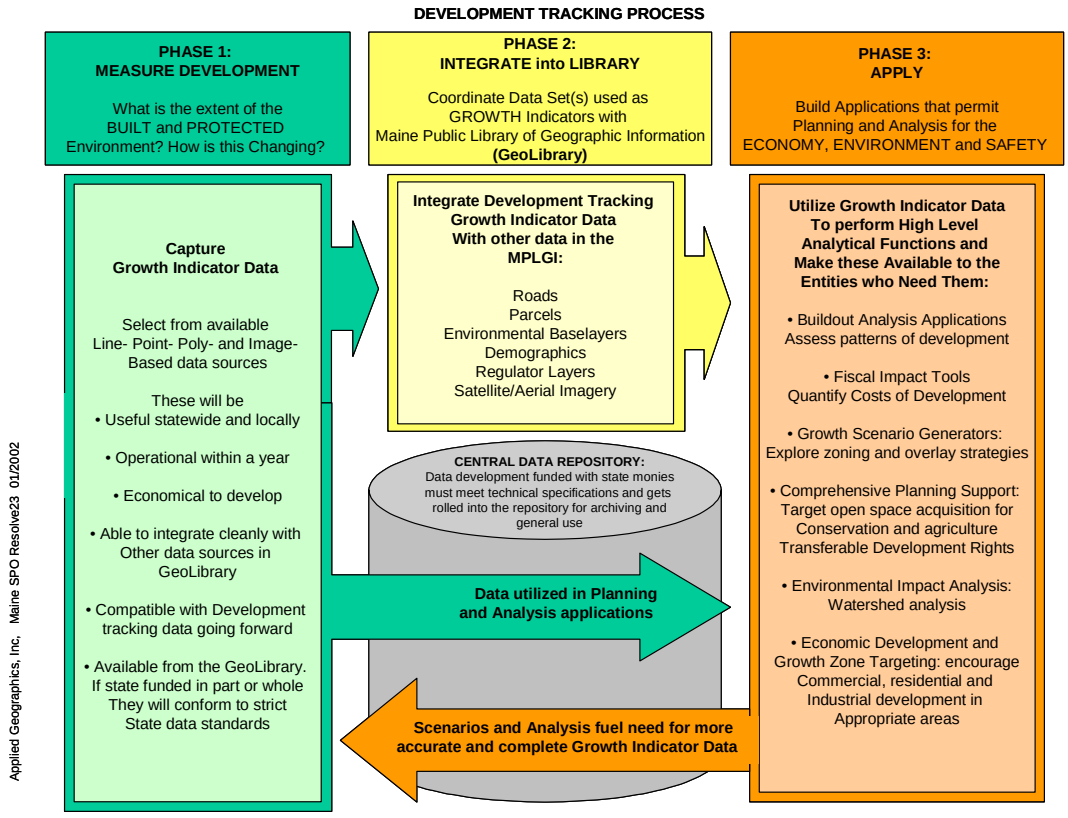

Figure 3-5: APPLICATIONS OVERVIEW

Combining this information with the many layers of regulatory, environmental, demographic and economic development data will permit development of a suite of tools that may be used to accurately and incisively track and manage development in the state. Descriptions of some of these follow.

3.4.1 Fiscal Impact Analysis Tools

An important, sophisticated application to permit Maine to analyze costs of recent development in order support more informed and better managed future development.

3.4.2 Buildout Analysis Applications

Utilizing many of the layers in the GeoLibrary, buildout analysis will examine all of the land resources of one or a collection of communities and assess the total amount of land within that area that may be legally or practically developed. Combined with exclusionary zoning data this sort of analysis can produce accurate totals of maximum allowable home and business construction, water consumption, waste production and population increase.

3.4.3 Scenario Generators

Either adding to the buildout analysis environment or starting from scratch, scenario generators permit users to test such inputs as additional zoning restrictions or special use overlays, changes to minimum lot sizes or setbacks from sensitive resources, and calculate the consequences of these changes. Assuming a town-wide minimum lot size of one acre, for instance, a town can apply a 5 acre minimum to a specified geographic area and generate numbers quantifying how this will diminish population and resource load totals. Integrating these data with information regarding school sizes, water distribution and sewage treatment capacities, or watershed phosphorus loading limitations will produce meaningful data that help to define sensible maximum growth targets.

3.4.4 Comprehensive Planning Map Support applications

Hundreds of communities throughout the state have completed comprehensive plans to guide their development. Most of the mapping and geographic data associated with these plans have not made it into GIS in such a way that it is accessible or useful going forward. Standardized mapping applications to support comprehensive planning should be developed to streamline the map-making process and ensure that data resources used in the plans do not get stranded in reports and orphaned from further use. Building these tools so that they use or favor data meeting statewide standards for the GeoLibrary will fuel the feedback loop of ever-increasing spatial data accuracy.

3.4.5 Environmental Impact Analysis

Using development tracking points and their attributes to describe new population growth, transportation analyses may be undertaken describing how movement will occur to and from these points or clusters. Air quality & fuel consumption from trip frequency & length may be calculated. Using DOT/MeGIS roads, comparative impervious surface calculations may be made between new and early development patterns.

3.4.6 Economic Development / Growth Zone Targeting

A final application type that will benefit enormously from current, accurate and accessible spatial data will be economic development tools. Encouraging robust economic development of desired types in appropriate locations is the Holy Grail of Smart Growth. GIS is indispensable in this exercise, and the better the data, the more likely such an application can be made reality.

An economic development application will know the environmentally suitable places to build, where regulations are favorable, what the neighborhood looks like, what the age, education and economics of the population are, what infrastructure (sewer, water, electric and transportation) systems are proximate and their carrying capacities, what properties are available for sale, and whom to contact to purchase one. It will be able to display this information clearly and quickly to anyone in the market with a computer and an Internet connection.

No statewide GIS can be considered mature until this type of application can be built and maintained and begins reaping genuine benefits for the State of Maine.

3.5 Recommendations for System Implementation

This analysis suggests that a point-based system utilizing one or more of the available indicators discussed above should be selected for short-term development tracking use. This layer should be augmented where feasible with parcel and/or fine-tuning based on air photo interpretation. It is also recommended that the multitude of data layers developed and incorporated into the Maine Public Library of Geographic Information be relied upon for analysis of the current and potential impacts of development.

To move this effort towards implementation, the following steps are recommended:

1. The State Planning Office should work with each of the parties responsible for management of the point indicators described in Section 3.2.1.2 to further document the mechanics of the collection of each of the point based indicators. Owners and maintainers of these data should be encouraged to participate in the data gathering elements of the development tracking system. Benefits to each party that would be asked to participate should be explored and marketed as a reward for transmitting data.

2. Following this analysis, the most meaningful and cost-effective method that meets the objectives laid out in Section 3.1 should be chosen for implementation. It is recommend that the State conduct a pilot level project as outlined in Section 3.3.3 to test one or more of the most promising approaches before implementing the system on a statewide basis.

3. A pilot area should be chosen to test and prove the concepts of point-based development tracking, and to uncover best procedures and establish costs for scaling the methodology to a statewide program. The pilot communities should end up with points that link cleanly to their respective assessing databases, are correctly positioned over existing structures, and are updated frequently and locally.

4. To the extent that the data collection serves a multitude of user needs, this project should be fully coordinated with the GeoLibrary and rely on the regional GeoService Centers for implementation assistance.

5. Data should be collected locally and validated centrally. Efforts should be taken to develop data input and maintenance software and procedures that permit input collaborators with deep local knowledge but little exposure to GIS to contribute meaningfully.

The following table contains a rough approximation of the costs associated with completing this initiative as both conservative and aggressive pilots and as a statewide project.

	Pilot: 5 Towns	Pilot: 50 Towns	Statewide
Points File Standards development and File Creation	$10,000	$10,000	$10,000
Application Creation: Point manipulation and tabular attribute editor	$50,000	$50,000	$75,000
GeoLibrary Data Validator Software writing and testing	$10,000	$10,000	$25,000
Training	$10,000	$30,000	$125,000
Data Capture and Maintenance Support	$20,000	$50,000	$240,000
Approximate Total Cost	$100,000	$150,000	$475,000

Table 3-3: APPROXIMATE PILOT COSTS